Enterprise Architecture Principles, Technology Infrastructure Standards, and Architecture Direction

The enterprise architecture (EA) will be based on **principles** and **standards** that focus on open standards, interoperability, resource sharing, and integration to support the overall mission of the Department, and guide decision making regarding information systems and technology investments. Standards will benefit USDA by reducing acquisition and maintenance costs, eliminating unnecessary interfaces, reducing the need for formal and ad hoc user training, and providing for more effective configuration management and reduced maintenance costs by minimizing the support and servicing of fewer disparate or non-compatible products.

USDA's architecture **direction** is heavily influenced by the Government's need to provide products and services in an information-intense environment. Government and public sector customers are more knowledgeable about information technology capabilities, and their expectations regarding delivery of services are increasing accordingly. New delivery mechanisms, such as the Internet and the focus on electronic government, provide USDA unprecedented opportunities for improving the way we do business.

Principles

Business Principles	Principle 1 – Business processes, and citizen and organizational information and services needs drive technology investments. Principle 2 – Business alignment is the basis for selecting processes for improvement and technologies for refreshment. Total business value consistent with the USDA strategic plan is the primary objective. Principle 3 – Program and customer services delivery are accomplished through maximum use of electronic government/commerce mechanisms. Principle 4 – A business case and an assessment of the risk-adjusted return-on-investment are required for approval of funding technology solutions.
Information Principles	Principle 1 – Information is an asset that must be properly and securely managed in all its forms according to its content and value to an organization. Principle 2 – Internal and public access to information are available from any place, at any time, and in the right format through the most economical, effective, and efficient means possible; and in accordance with privacy rules.

Application Principles	Principle 1 – Commercial off-the-shelf technology solutions are used wherever possible rather than customized or in-house solutions to meet business and information technology requirements. Principle 2 – Applications are a shared USDA resource, and are available to any Agency having similar business needs to reduce costs and duplication. Principle 3 – Applications are developed with the active participation of customers using methods that reduce risk, emphasize quality, and reduce development costs. Principle 4 – Applications are designed for long-term viability, low-cost maintenance, and architectural compatibility.
Data Principles	Principle 1 – Data are collected once wherever practical and cost effective, and maintained and made sharable internally and externally in accordance with established standards, and with minimum impact on the public. Principle 2 – Data are assets that are managed to the benefit of USDA and its Agencies. Principle 3 – Data are shared consistent with security and privacy requirements.
Technology Principles	Principle 1 – The technology infrastructure is based on open systems concepts and standards to assure universal access and interoperability. Principle 2 – Technology components of the Enterprise Architecture are standardized across Agencies wherever common USDA business requirements exist. Principle 3 – The technology infrastructure uses reliable, proven, and cost-effective advances in technology. Principle 4 – The technology infrastructure is to meet established performance and security needs. Principle 5 – A technology refreshment process will guide future technology infrastructure investments to enable continued effective program and services delivery. Principle 6 – All hardware and software technologies are USDA capital assets that must be effectively and efficiently tracked and managed, and shared wherever practical; and guide future technology acquisitions.

Technology Infrastructure Standards

Server Operating System

Server Operating System defines the operating services responsible for the management of platform resource enabled services and the applicable standards for the future technical environment. The controlling software that provides for the efficient delivery of computing capabilities with continuous availability and complete data integrity. Server operating system services are responsible for the management of platform resources, including the processor, memory, files, and input/output. They generally shield applications from the implementation details of the machine.

In setting the standards for server operating system(s), the following criteria are considered:

- Simplified technical support given the diversity of current operating systems used
- Increased portability (application and system) across USDA to aid in reorganization efforts
- Improved scalability
- Increased feasibility to implement remote computing
- Increased facility for remote systems
- Administration and network support and performance monitoring
- Increased accessibility to USDA information (internal and external)
- Increased interoperability with USDA agencies and their partners.

Characteristic of the services provided by operating systems include, but are not limited to:

- Kernel operations to create and manage processes and threads of execution; execute programs; define and communicate asynchronous events; define and process system clock operations; implement security features; managing files and directories; control I/O processing to and from peripheral devices
- Command interpreter and utility services to compare, print, and display files; edit files; search patterns; evaluate expressions; log messages; move files between directories; sort data; execute command scripts; provide local print spooling; schedule signal execution processes; access environment information
- Batch processing
- File and directory synchronization.

Appropriate standards governing operating systems include currently:

- NIST FIPS PUB 189 (POSIX.2)
- NIST FIPS PUB 151-2 (POSIX.1)
- IEEE 1003.1c: 1994

Data Interchange

Data interchange services provide specialized support for the interchange of information between applications and the external environment. These services are designed to handle data interchange between applications on the same platform as well as applications on different (heterogeneous) platforms.

In setting the standards for data interchange, the following criteria are considered:

- Improved exchange of information internally and externally among Agencies, Department, State/Local Governments, citizens/customers, trade associations, advocacy groups, and others
- Improved collaboration opportunities internally and externally
- Increased accuracy through data reuse (i.e., collect once; use many times)
- Improved capacity to update data
- Improved data consistency.

Characteristic of the services associated with data interchange include, but are not limited to:

- Document generic data typing and conversion
- Graphics data interchange
- Geospatial data interchange
- Specialized data interchange
- Electronic data interchange
- Fax
- Raw graphics interface
- Text processing
- Document processing
- Publishing
- Video processing
- Audio processing
- Multimedia processing
- Media synchronization
- Information presentation and distribution
- Hypertext

Appropriate standards governing data interchange include currently:

- NIST FIPS PUB 173-1 (Spatial Data Transfer Standard) Geospatial data exchange
- NIST FIPS PUB 1-2 (Code for Information Interchange) Characters and symbols - Character sets
- ISO 11172-1,2,3:1993 (MPEG) Compression - Motion image compression
- ISO/IEC 10918-1 (JPEG) Compression – Motion image compression
- X/Open C436:1994 (Commands and Utilities) Compression - Text and data compression
- NIST FIPS PUB 152 (SGML) Document interchange – Custom definition of document types
- NIST FIPS PUB 161 Electronic Data Interchange
- NIST FIPS PUB 177 (IGES) Technical data interchange – Vector graphics data interchange
- ISO/IEC 9592-4:1992 (PHIGS PLUS) Vector graphics – Vector graphics API
- NIST FIPS PUB 153 (PHIGS) Vector graphics -Vector graphics API
- NIST FIPS PUB 128-1 (CGM) Vector graphics -Vector graphics data interchange

Data Management

Central to the successful implementation of most data management or applications systems is the capability to manage data that can be shared among many processes or user applications. Data management efforts include the support, administration, and storage of shared data, the use of data dictionary services to aid in defining database structure, and the use of database management system software to provide controlled access to and modification of structured data.

In setting the standards for data management, the following criteria are considered:

- Improved accessibility between commonly used applications from among Agencies, Departments, State/Local Governments, citizens/customers, trade associations, advocacy groups, and others
- Improved capability to reuse data
- Improved consistency and accuracy of data
- Increased responsiveness to change agents and evolving business needs
- Improved timeliness in the development and implementation of applications.

Characteristic of the services associated with data management include, but are not limited to:

- Data dictionary/repository
- Database management systems (DBMS)
- Object-oriented database management systems (OODBMS)
- File management
- Query processing
- Screen generation
- Report generation
- Networking/concurrent access

Appropriate standards governing data management include currently: • NIST FIPS PUB 156 (IRDS) Data dictionary/directory services • NIST FIPS PUB 127-2 (SQL) Database language SQL • NIST FIPS PUB 193 (SQL Environments) Data management system

Transaction Processing

Transaction processing services provide support for the on-line processing of information in discrete units called transactions, with assurance of the state of information at the end of the transaction. This typically involves predetermined sequences of data entry, validation, display, and update or inquiry against a file or database. It also includes services to prioritize and track transactions. Services may include support for distribution of transactions to a combination of local and remote processors. Typically, a transaction processing service will contain a transaction manager, which links data entry and display software with processing, database, and other resources to form the complete service. The sum of the work done anywhere in the system in the course of a single transaction is called a global transaction.

In setting the standards for transaction processing, the following criteria are considered: • Improved exchange of information internally and externally among Agencies, Department, State/Local Governments, citizens/customers, trade associations, advocacy groups, and others • Improved collaboration opportunities internally and externally • Increased accuracy through data reuse (i.e., collect once; use many times) • Improved capacity to update data • Improved data consistency.
Characteristic of the services associated with transaction processing include, but are not limited to: • Transaction manager and status monitor • Transaction initiation • Opens and closes resource managers • Transaction commit or rollback • Transaction chaining • Resource manager • Access to shared resources such as databases, file access systems, or communications facilities

Appropriate standards governing transaction processing include currently:

- NIST FIPS PUB 173-1 (Spatial Data Transfer Standard) Geospatial data exchange
- NIST FIPS PUB 1-2 (Code for Information Interchange) Characters and symbols - Character sets
- ISO 11172-1,2,3:1993 (MPEG) Compression - Motion image compression
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Supporting Hardware

Supporting hardware includes a full-range of productivity enhancing tools, including personal digital assistants (PDAs); personal computers and laptops; X-terminals and thin clients, peripheral devices (e.g., printers, plotters, scanners, digitizers, etc.); mid-range processors (e.g., smaller servers and workstations); and large servers.

In setting the standards for supporting hardware, the following criteria are considered:

- Improved exchange of information internally and externally among Agencies, Department, State/Local Governments, citizens/customers, trade associations, advocacy groups, and others
- Improved collaboration opportunities internally and externally
- Increased responsiveness to change agents and evolving business needs
- Increased capability and efficiency to back up and restore key USDA and Agency data and information
- Simplified technical support and maintenance of all devices
- Improved ease of use of devices by the end user
- Improved scalability across a wide range of devices for a given equipment type (e.g., servers, PCs)
- Increased accessibility to all types of devices and the data and information on which they operate by users in need of accommodations
- Improved support and systems and asset management tools and capabilities across a wide range of local and remote systems
- Easily accessible, quality training and support mechanisms for systems managers and end users
- Increased accessibility to USDA information (internal and external)
- Increased interoperability with USDA agencies and their partners.

Characteristic of the services associated with supporting hardware include, but are not limited to:

- Software storage
- Memory management
- Power user processing
- Portable computing
- Pen-based computing
- Personal productivity enhancement

The appropriate standards governing supporting hardware technologies are embedded in the preceding and following technology area descriptions, and are not unique to this technology category.

Graphical User Interface

User interface services define how users interact with an application on local or remote systems. A graphical user interface (GUI) provides a consistent "look and feel" through the use of a "window manager." The GUI consists of graphical objects such as windows, menus, icons, and pointers, which allow users to access and use data, graphical images, and applications.

In setting the standards for graphical user interfaces, the following criteria are considered:

- A consistent look and feel across platforms, and across applications operating on these platforms
- Easy and intuitive for the end user without specific knowledge of the GUI
- Access to existing systems or applications via the GUI
- Sufficiently robust to allow systems administrators to more easily manage their systems.

Characteristic of the services associated with graphical user interfaces (GUI) include, but are not limited to:

- Graphical client-server interfaces
- Object display
- Window management
- User dialogue support
- Printing services
- Computer-based training and on-line help
- Terminal emulation
- X-Windows

Appropriate standards governing graphical user interfaces include currently:

- NIST FIPS PUB 158-1 (X-Windows) GUI Client-Server Operations - Data interchange format for GUI- based applications.

Note: Additional interfaces can be employed by USDA where specific mission needs, cost considerations, or support of individual personnel considerations require it.

Office Automation

Office automation software provides administrative support for completing daily business functions. A wide range of tools separately or in combination characterize this group of software, including spreadsheets, business graphics, presentation packages, personal data bases, word processing, project management and scheduling, calendars, desktop publishing, multi-media, terminal emulation, web browser, document imaging, mail, groupware, and executive information systems (EIS).

In setting the standards for office automation tools, the following criteria are considered:

- Improved exchange of information internally and externally among Agencies, Department, State/Local Governments, citizens/customers, trade associations, advocacy groups, and others
- Improved collaboration opportunities internally and externally
- Increased responsiveness to change agents and evolving business needs
- Simplified technical support and maintenance of all applications
- Improved ease of use of applications by the end user
- Increased accessibility to all application features by users in need of accommodations
- Easily accessible, quality training and support mechanisms for systems managers and end users
- Increased accessibility to USDA information (internal and external)
- Increased interoperability with USDA agencies and their partners.

Characteristic services associated with office automation tools are generally self-explanatory based on the function of a specific tool.

Appropriate standards governing office automation tools include currently:

- ITU-T X.400 Mail and X.500 Directory Services
- Internet RFC 821: SMTP
- Internet RFC 1327/1495 (SMTP to X.400 gateway) Application-oriented network services
- Internet RFC 1041 (TN3270) Access to mainframe systems
- Internet RFC 1647 (TN3270E) Access to mainframe systems
- NIST FIPS PUB 1-2 (Code for Information Interchange) Characters and symbols – Character sets
- ISO 11172-1,2,3:1993 (MPEG) Compression - Motion image compression
- ISO/IEC 10918-1 (JPEG) Compression - Motion image compression
- X/Open C436:1994 (Commands and Utilities) Compression - Text and data compression
- NIST FIPS PUB 152 (SGML) Document interchange – Custom definition of document types
- NIST FIPS PUB 152 (SGML) Document interchange – Document exchange
- NIST FIPS PUB 177 (IGES) Technical data interchange – Vector graphics data interchange
- ISO/IEC 9592-4:1992 (PHIGS PLUS) Vector graphics – Vector graphics API
- NIST FIPS PUB 153 (PHIGS) Vector graphics -Vector graphics API
- NIST FIPS PUB 128-1 (CGM) Vector graphics -Vector graphics data interchange
- HTML (HyperText Markup Languages) 3.0
- HTTP (NCSA Standard NTTP protocols)

Geographic Information Systems (GIS)

Within this section, GIS is defined as the software, data, and procedures used to acquire, store, manage, analyze, view, and print geographic data. Geospatial and associated attribute data are referenced to the surface of the earth through a coordinate system. Many USDA business activities occur in a specific location; particularly for the land management and Service Center agencies. The relationship of natural and cultural resources and the impacts of alternative management practices on them can best be analyzed and portrayed geospatially. Maps are very powerful means of conveying a maximum amount of information on topics as diverse as animal damage assessments, forest management plans, risk management studies, and conservation plans. Tight integration between geoprocessing functions and database management systems is required for effective use of GIS within USDA.

In setting the standards for GIS, the following criteria are considered:

- Improved exchange of information internally and externally among Agencies, Department, State/Local Governments, citizens/customers, trade associations, advocacy groups, and others
- Improved collaboration opportunities internally and externally
- Increased responsiveness to change agents and evolving business needs
- Simplified technical support and maintenance of all applications
- Improved ease of use of applications by the end user
- Increased accessibility to all application features by users in need of accommodations
- Easily accessible, quality training and support mechanisms for systems managers and end users
- Increased accessibility to USDA information (internal and external)
- Increased interoperability with USDA agencies and their partners.

Characteristic of the services associated with geographic information systems include, but are not limited to:

- Graphical object management (to include geospatially referenced data)
- Drawing
- Imaging

Appropriate standards governing geographic information systems are evolving. The closest to a standard that currently exists is the Open Geodata Interoperability Specification (OGIS), a comprehensive software framework for distributed access to geodata and geoprocessing resources that will provide a detailed common interface template for writing software to interoperate with other OGIS compliant software. USDA supports the efforts and direction of the developing OGIS standard.

Software Engineering

The functional aspect of an application is embodied in the programming languages or packaged tools used to develop it. The software development process requires tools appropriate to the development and maintenance of applications. Among the tools which characterize this group of software are software engineering tools, including computer aided software engineering (CASE), object oriented programming (OOP), requirements management and tracking software, automated software testing tools, and artificial intelligence/expert systems.

In setting the standards for software engineering tools, the following criteria are considered:

- Efficiency in code development
- Capability for replication and reuse
- Support for rapid prototyping
- Reduced maintenance costs
- Ease of use by the end user
- Ease of customization of systems
- Ease of system integration
- Increased portability of data across organizational boundaries
- Increased software reliability.

Characteristic of the services associated with software engineering tools include, but are not limited to:

- Programming languages
- Object code linking
- CASE tools
- Graphical user interface (GUI) building
- Scripting languages
- Language bindings
- Runtime environment tools
- Application binary interfaces
- Verification and validation

Appropriate standards governing software engineering tools include currently:

- ANSI/IEEE 1209-1992 (Evaluation and Selection of CASE Tools) CASE/Software development environment
- NIST FIPS PUB 160 (C) Programming languages - C and C++
- NIST FIPS PUB 21-4 (COBOL) Programming languages – COBOL
- ISO 1539:1990 (FORTRAN-90) Programming languages – FORTRAN
- NIST FIPS PUB 69-1 (FORTRAN-77) Programming languages – FORTRAN
- NIST FIPS PUB 125-1 (MUMPS) Programming languages – MUMPS
- ANSI/IEEE 1016-1987 (Recommended Practice for Software Design Descriptions) Software design
- ANSI/IEEE 1016.1-1993 (Guide for Software Design Descriptions) Software design

Integration Technologies

Integrating technologies have a pervasive effect on the operation of most or all of the functional services categories. The following classes of systems and tools characterize "integration technologies:" security, interfaces, object services systems, network management information systems, and systems life cycle management methods.

In setting the standards for integration technology tools, the following criteria are considered: • Reduced maintenance costs • Ease of use by the end user • Ease of customization of systems • Ease of system integration • Increased portability and security measures for data and information across organizational boundaries • Increased software reliability.
Characteristic services associated with integration technology tools are embedded throughout the preceding and following technology area descriptions, and are not unique to this technology category.
Likewise, the appropriate standards governing integration technology tools are embedded in the preceding and following technology area descriptions, and are not unique to this technology category.

Telecommunications

The USDA EA telecommunications component of the technology infrastructure requires that new or upgraded private branch exchanges (PBX) throughout USDA conform to National ISDN Agreements. The USDA telecommunications network will interconnect agency networks and lead to improve internal communications and information sharing. Standardization of network interfaces and protocols will enable sharing of telecommunications resources in field offices and consolidation of traffic on backbone circuits, reducing complexity and ensuring more consistent performance.

In setting the standards for telecommunications hardware, the following criteria are considered:

- Improved exchange of information internally and externally among Agencies, Department, State/Local Governments, citizens/customers, trade associations, advocacy groups, and others
- Improved collaboration opportunities internally and externally
- Increased responsiveness to change agents and evolving business needs
- Increased capability and efficiency to back up and restore key USDA and Agency data and information
- Simplified technical support and maintenance of all devices
- Improved scalability across a wide range of LAN and WAN configurations
- Increased accessibility to a wide range of devices by users in need of accommodations
- Improved support and systems and asset management tools and capabilities across a wide range of local and remote systems
- Easily accessible, quality training and support mechanisms for systems managers and end users
- Increased accessibility to USDA information (internal and external)
- Increased interoperability with USDA agencies and their partners.

Characteristic of the services associated with telecommunications include, but are not limited to:

- Data communications
- Electronic mail
- Enhanced telephony
- Shared screen
- Video conferencing
- Broadcast
- Mailing list usage

Appropriate standards applicable to all aspects of telecommunications include currently:

- FIPS PUB 146-2, POSIX, implementation of TCP/IP for Wide Area Network (WAN) transmission and related RFCs. OSI implementation of 146-2 should include a TCP/IP gateway
- RFC 791, IP definition for Wide Area Network (WAN) transmission
- RFC 1771, Border Gateway Protocol (BGP) for demarcation point access to network
- SNMP II management protocol across the USDA network.
- Ethernet II, IEEE 802.3, or IEEE 802.xx (100mbps) for Local Area Networks (LANs).
- FIPS PUB 174, Federal Building Telecommunications Wiring Standard
- FIPS PUB 175, Federal Building Standards for Telecommunications Pathways and Spaces
- FIPS PUB 176, Residential and Light Commercial Telecommunications Wiring Standard
- FIPS PUB 187, Administrative Standard for the Telecommunications Infrastructure of Federal Buildings
- FIPS PUB 195, Federal Building Grounding and Bonding Requirements for Telecommunications
- NIST Special PUB 500-217, IGOSS-Industry/Government Open Systems Specification.
- X.500 Directory Services
- X.400 and SMTP (RFC 827) implemented as mail standard or gateway functions.

Video Telecommunication

Management of an organization the size of the USDA and with its geographic distribution requires the need at times to bring people together in near face-to-face ways to resolve issues, to collaborate on projects, and to coordinate major programmatic activities. To improve internal and external communications one method is to use Video Teleconferencing (VTC) capabilities across USDA. It is expected that a wide variety of VTC applications will support the different needs of the Department and its Agencies. The USDA VTC applications will include: (a) multimedia conferencing application supporting the exchange of video, voice, image, and data; (b) distance learning using point-to-multi-point connections; and (c) collaboration applications enabling 'virtual teaming' and information sharing. The types of functions or elements that video telecommunications should include are: a switched based infrastructure with Wide Area Network (WAN) access; video dialing for universal availability; inverse multiplexing for higher conference speeds and better quality of service; multi-point video conferencing capabilities; a reservation system for managing video conferencing resources; gateways for end-to-end LAN, WAN, and ATM backbone connectivity; and comprehensive remote network management for easy troubleshooting and equipment support.

In setting the standards for video telecommunications, the following criteria are considered:

- Reduced maintenance costs
- Ease of use by the end user
- Ease of customization of systems

Characteristic of the services associated with video telecommunications include, but are not limited to:

- PC-to-PC conferencing
- Conference room-to-conference room video

Appropriate standards, in addition to those identified under the general topic of telecommunications above, applicable to video telecommunications include currently:

- International Telecommunications Union – Telecommunications Sector (ITU-T) recommendations:
  - H.320 for narrow-band ISDN (N-ISDN) requirements. N-ISDN includes Basic Rate ISDN and Primary Rate ISDN.
  - H.321 for ATM requirements.

Telecommunications Security

The telecommunications network represents the basic transport functionality and related processes, including electronic mail interoperability, Internet access, and remote access. Security services are a critical component of any network, and they will be provided as mandatory or discretionary (protections can be based on risk and value).

In setting the standards for telecommunications security, the following criteria are considered:

- Provide data confidentiality and integrity
- Provide high up-time availability
- Provide accountability for all systems managers and users.

Characteristic of the services associated with telecommunications security include, but are not limited to:

- Network management and gateway services for electronic mail interoperability and web access
- Internet access
- Remote access

Appropriate standards, in addition to those identified under the general topic of telecommunications above, applicable to telecommunications security include currently:

- International Organization for Standardization (ISO) - Open Systems Interconnection (OSI) Reference Model (ISO/DIS 7498)

Architecture Direction

USDA's FUTURE ARCHITECTURE
Strategic goal planning, collaboration, and resource sharing Evolution based on USDA-wide principles and standards
BUSINESS
Business: • Strategic process focus
Information: • Widely publicized and easily accessible • Managed to support planning, current business, and historic purposes • USDA-wide knowledge management program
Applications: • Reuse of common process modules • Organized and developed in segments by topic • Reliance on E-commerce and E-government • Minimized paper-based delivery
Data: • Managed as a USDA-wide shareable resource • Optimized for USDA-wide transaction processing, reporting, and analytical processing
TECHNOLOGY
Technical Platforms: • Standards based acquisition and configuration • Improved interoperability, portability, and scalability • Increased sharing of technology components • Seamless capabilities, elimination of costly unnecessary interfaces • Automated software maintenance
Telecommunications: • Integrated wide- and local-area networks • Desktop to desktop service • Sufficient capacity for managed growth • Support for data, text, graphics, sound, image, spatial, and video formats • Connectivity for mobile and radio operations
Security: • USDA-wide, consistent protection of IT assets from unauthorized access, use, and alteration • Security issues integrated into planning, acquisition, implementation, and operations